WETLAND RESTORATION
(acres)
CODE 657

Natural Resources Conservation Service
Conservation Practice Standard

I. Definition

The restoration of a drained wetland or the rehabilitation of a degraded wetland to provide the hydrological and biological benefits and functions of a wetland system.

II. Purpose

This practice is used to restore the hydrologic conditions and hydrophytic plant community necessary for the reestablishment of wetlands for the benefit of wildlife and plant and animal biodiversity, reduce flooding, improve water quality, and provide other environmental benefits.

III. Conditions Where Practice Applies

This practice applies to hydric soils that were drained or altered, and that are capable of storing water for the development of a wetland system.

This practice does not apply to:

- constructed wetlands designed for treatment of agricultural, industrial, or municipal wastes,
- artificial wetlands that are created on non-hydric soils, and
- existing non-degraded wetlands with intact native plant communities.

Where embankments are a component of the restoration, this standard is applicable to:

a) *structural heights*[1] of 10 feet or less;
b) embankments with less than 50 acre-feet of storage capacity;
c) embankment structures that are *class "a;"*
d) drainage areas of 160 acres or less; and
e) embankments that are constructed in series where each is less than five feet in structural height and the cumulative storage capacity is less than 50 acre-feet.

Drainage areas exceeding 160 acres or structural heights greater than 10 feet will be designed in accordance with NRCS Standard 378, Pond, Section IV, Field Office Technical Guide (FOTG).

IV. Federal State and Local Laws

All wetland restoration activities shall comply with all federal, state, and local laws, rules or regulations governing flooding, surface and subsurface drainage, excavation, filling, and any other wetland-related activities. The landowner or agent is responsible for securing required permits before restoration. This standard does not contain the text of the federal, state, or local laws governing wetland restoration.

Interagency coordination of wetland restoration project site selection, planning, and approvals early in the planning process is essential to meet the various requirements of technical and regulatory agencies.

V. Criteria - Establishes the minimum allowable limits for design parameters, acceptable installation processes or performance requirements.

A. General Criteria

1. The effect of any modification to the existing surface and/or subsurface drainage system on upstream, adjacent, and downstream landowners will be evaluated in the design. Upstream surface and subsurface drainage will not be impacted unless appropriate written permissions are obtained or mitigation measures are implemented.

2. Excessive nutrient, pesticide, or other pollutant inflows will be controlled prior to site restoration. Examples of excessive inflows include direct runoff from a feedlot or other obvious pollution source, an actively eroding gully emptying into the site, or a poorly treated watershed

[1]Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

that is contributing sediment and its associated pollutants.

3. Wetland *hydrology of the site* should be restored or replaced as close as possible to its condition prior to manipulation. As a minimum, the hydrologic soil condition must be able to support hydrophytic vegetation.

4. The lateral effects of existing drainage systems on or adjacent to the proposed restoration site must be addressed in planning and designing the wetland restoration.

B. Specific Criteria - Wetlands may be restored using any combination of the following:

1. **Excavation** - Where an area containing hydric soil has been covered by sediment, land shaping or other activities, the wetland hydrology may be restored by excavating (scraping) the fill material and/or the sediment from the site.

   a. Soil borings should be conducted to determine the approximate original hydric soil surface.

   b. Excavated areas (scrapes) may also be constructed to provide diversity of habitat and to provide a source of fill materials for embankments or ditch plugs within the same wetland area. In this case, excavation may occur below the original hydric soil surface.

   c. Newly excavated spoil not used in embankment or ditch plug construction shall not be disposed of in the following:

      - U. S. Army Corps of engineers jurisdictional wetlands,
      - Existing non-degraded wetlands with intact native plant communities,
      - Areas that will degrade functional values of the restored wetland.

      Newly excavated spoil may be:

      - Removed from the wetland area, or
      - Utilized to construct nesting islands, or
      - Placed below the planned normal water elevation to establish features beneficial for plant and animal biodiversity, or
      - Spread above the planned normal water elevation in a layer averaging not more than 3 inches, but only in areas where the functional values of the restored wetland will not be degraded.

   d. Wetland side slopes, shape, and size should approximate the original wetland configuration. When this cannot be determined, excavated scrapes shall have the following characteristics:

      - side slopes of 8:1 or flatter,
      - maximum depth of 4 feet,
      - size range from 0.1 acre to 1.0 acre, and
      - a minimum 25-foot wide vegetated buffer area surrounding the scrape.

   e. In addition, excavated scrapes generally should include:

      - an irregular shape to adapt to the site,
      - native hydrophytic plant seed banks preserved for re-vegetation.

2. **Subsurface Drain Removal or Destruction** - The effects of a subsurface drainage system may be eliminated by performing one or more of the following:

   - removing or rendering inoperable a portion of the drain,
   - modifying the drain with a water control device, or
   - installing non-perforated pipe through the wetland site.

   a. The minimum length of drain to be removed or rendered inoperable is shown in Table 1. Plan for additional tile removal based on an evaluation of

land grade, drain grade, and depth of the drainage system. Also, consider lateral effects of the outlet ditch when determining tile removal locations. If present, underground reservoirs for drainage pumping plants shall be removed, crushed, or filled and capped.

b. If present, all sand and gravel bedding and filtering material or other flow enhancing material will also be removed. The trench will be filled or compacted to achieve a density equal to the adjacent material.

c. Where embankments will be constructed, all subsurface drains shall be removed starting at one-half the minimum distance shown on Table 1 downstream of the embankment center line and extending to 15 feet upstream from the upstream toe of the embankment.

d. Installation of non-perforated subsurface drain around or through the wetland may be necessary to allow upstream drainage systems to continue to function properly.

e. Functional subsurface drains downstream of the wetland shall have an end cap installed on the upstream end or other satisfactory end seal to prevent soil from filling the drain.

3. **Surface Drain Filling** - Where open channels and shallow surface drains provide surface and subsurface drainage, the channel or surface drain will be:

- totally filled with earth, or
- filled with a single ditch plug or a series of ditch plugs to the full depth of the ditch according to Table 1, or
- filled with a ditch plug to a height less than the full depth of the ditch according to Table 1 and have an outlet designed according to NRCS Standard 410, Grade Stabilization Structure, or NRCS Standard 587, Structure for Water Control.

a. Where open channels and shallow surface drains provide only surface drainage, restoration may be achieved using an embankment. See criteria for Embankments.

b. Plan the number and spacing of ditch plugs based on an evaluation of land grade, drain grade, and depth of the drainage ditch. The end slopes on ditch plugs will be 3:1 or flatter on the down-stream side and 5:1 or flatter on the wetland side.

c. All fill will be compacted as needed to achieve the desired densities. To account for settlement, the earthfill height will be increased by at least 5% for mineral soils compacted by construction equipment operating over the fill area, and by at least 10% where fill is dumped, bulldozed, and shaped with limited compaction. The earthfill height will be increased by 20% where a mixture of mineral and organic soils is used. All fills using organic soils shall be increased by at least 33% to account for settlement.

d. Provisions will be made to store, pass, or divert the 10-year, 24-hour storm flow so that it does not cause erosion and flooding impacts where it enters any downstream facilities. Earthfill materials shall be placed such that there will be no flow over the ditch plug during a 10-year, 24 hour storm except where a grade stabilization structure or structure for water control is used. A minimum of 0.5 feet shall be included in the settled fill height of a ditch plug above the adjacent original ground surface for freeboard to insure that flows will be directed around the plug. A flow control device will be used where flow duration and rate would otherwise cause erosion and head cutting.

Table 1

Minimum length of subsurface drain to be removed or rendered inoperable
or
Minimum length of surface drain to be filled with ditch plug.
(The length is measured parallel to the direction of the surface drain flow along the top of the settled ditch plug.)

*Soil Permeability (inches per hour)	*Soil Texture	**Minimum Distance
> 2.0	Sandy & Organics	150 feet
0.6 - 2.0	Loamy	100 feet
< 0.6	Clayey	50 feet

* Soil texture and permeability are for the general soil profile, not just the surface layer. Where the permeability and texture vary throughout the profile, consider the type of drainage system and which layer(s) are critical. Standard values for permeability and texture for each soil map unit are in the Field Office Technical Guide.

** Lateral effects of drainage features computed according to EFH Chapter 19 procedures can be substituted for the minimum distances shown in Table 1 (except for drains under embankments).

4. Embankments - An earth embankment may be constructed to restore a wetland. Embankments generally are placed above the original ground surface to impound water above ground.

a. The embankment shall be constructed of earthfill according to general embankment criteria in Table 2.

b. Organic soils shall not be used for embankments exceeding 5 feet in structural height.

c. Where existing embankments (dikes, levees, spoil berms, etc.) are present, the materials, dimensions, and structural soundness must be evaluated to determine suitability for the intended use.

d. Embankments should be located and shaped in a manner that is compatible with the existing landscape.

Table 2

GENERAL EMBANKMENT CRITERIA

Top width - 8 feet minimum for mineral soils and 16 feet minimum for organic soils.

Side slopes - 5:1 or flatter upstream and 3:1 or flatter downstream.

Settlement - The constructed height shall be increased by 5% for mineral soils, 10% for mineral soils with limited compaction, 20% for mixed soils, and 33% for organic soils, similar to requirements for surface drain filling.

Site preparation - Include a cutoff trench as needed to reduce seepage losses. Topsoil and debris must be removed under the embankment.

Spillway capacity - A spillway or combination of spillways shall pass the discharge from a 10-year, 24-hour storm for drainage areas up to 80 acres and a 25-year, 24-hour storm for drainage areas between 80 and 160 acres. The spillway design may utilize any credit for detention storage.

Vegetated Spillway* - The spillway shall have a 20-foot minimum level section measured in the direction of flow. Use natural vegetated spillways wherever possible. Spillways on natural ground are considered level if the elevation change is no more than 0.2 feet throughout the 20-foot length. Flow from the spillway must reenter any downstream channel at a non-erosive velocity.

Freeboard - A minimum of 0.5 feet shall be added to the design flow depth for freeboard for any spillway.

* Vegetated spillways may be designed using pages 11-WI-6, 7, 10 or 11 or 11-54a, 11-56a and b in the Engineering Field Handbook (EFH). Vegetated spillways can be designed for one or both ends of the embankment. Table 3, may be used to meet the vegetated spillway criteria noted in Table 2.

Table 3

Minimum Bottom Widths for Vegetated Spillways*		
Maximum Drainage Area (Acres)	Spillway Bottom Width (feet)	
	1 ft. flow depth**	1.5 ft flow depth**
10	12	10
20	23	10
30	33	15
40	43	19
40-80	------ 10-year, 24-hour storm ------	
80-160	------ 25-year, 24-hour storm ------	

* Based on a 10-year, 24-hour discharge for drainage areas up to 40 acres and 3:1 spillway side slopes with no flood routed detention storage.

** Spillway flow depth does not include freeboard.

5. Spillways for Embankments - A stable spillway shall be used where:

- a base flow exists, or
- there is a potential for a prolonged low flow, or
- there is a potential for frequent flow.

a. A stable spillway may be a pipe conduit, weir structure, chute spillway, lined or stone-centered waterway.

b. Spillways designed to handle base flows shall have a minimum capacity of twice the base flow rate. The minimum pipe diameter, if used, shall be 4 inches.

c. Antiseep collars, or filter and drainage diaphragms, shall be installed around the pipe conduit in the normal saturation zone if any of the following conditions exist:

(1) The conduit is of smooth pipe larger than 8 inches in diameter.

(2) The conduit is of corrugated metal pipe larger than 12 inches in diameter.

(3) The head from the crest of the spillway to the flow line of the outlet channel exceeds 5 feet.

d. If the pipe is connected to a subsurface drain, the drain must be non-perforated downstream from the embankment center line for one half the minimum distance shown in Table 1.

e. The inlet invert of a pipe shall be a minimum of 0.5 feet below the crest of any vegetated spillway.

f. Rock structures shall meet the stone size and gradation requirements of NRCS Standards 412, Grassed Waterway; 468, Lined Waterway or Outlet; or 410, Grade Stabilization Structure.

g. Where wetland water level manipulation may be desired, other structural details shall meet the requirements of NRCS Standard 587, Structure for Water Control, as applicable.

h. Pipe components shall meet material requirements of NRCS Standards 620, Underground Outlet; 606, Subsurface Drain; or 378, Pond.

i. Materials and design of filter and drainage diaphragms shall be in accordance with NRCS Technical Release No. 60, Earth Dams and Reservoirs.

6. Vegetation - Hydrologic conditions including duration, depth, and timing are primary factors in vegetation reestablishment. In some cases, vegetation after restoration can be predicted from historic records or existing vegetation on similar soils on nearby sites.

a. In normal situations, rely on existing seed banks in the soil and seed colonization from nearby wetlands to revegetate the wetland.

b. If there are special circumstances that would require planting the wetland, the vegetation selected should be compatible with the planned hydrologic condition. Examples of special circumstances would include restoring an isolated wetland that has been in crop production for many years or where there is a high probability that non-native or aggressive plant species will invade a restoration site.

c. A specific site planting plan will be developed which will include the species to be planted, amounts and establishment procedures according to NRCS Standard 342, Critical Area Planting.

d. Native plants are strongly recommended in a wetland site planting plan.

e. Disturbed areas on or near wetland restoration sites including embankments, constructed earth spillways, ditch plugs, or other non-vegetated areas (spoil disposal sites, construction haul roads, or similar areas) shall be re-vegetated according to NRCS Standard 342, Critical Area Planting.

VI. Considerations

1. Wherever possible, this practice should be applied to sites that are adjacent to existing wetlands to increase wetland system complexity and diversity, decrease habitat fragmentation, and ensure colonization of the site by wetland plants and animals. A complex of multiple smaller wetland excavations (scrapes) are biologically more beneficial than a single larger unit.

2. Vegetated buffer areas should be planned around all wetland restorations. For optimum nesting cover, a ratio of 4:1 (buffer area : water surface area) is recommended.

3. Consider extra safety requirements for embankments constructed in series.

4. Where wetlands may pose a hazard to people, consider means to direct people away from hazards (fencing, warning signs at access points, etc.), or consider measures in design and construction of the wetland restoration to reduce hazards.

5. Sediment delivery to restored wetlands from surface water inflow should be minimized. This may be accomplished with watershed treatment, grassed or riparian filter areas, or sediment basins.

6. Additional excavations within or connected to the normal water area of the wetland should be considered to add biodiversity potential.

7. For control recommendations of undesirable or nuisance plant and animal species, consult references listed in a Wisconsin supplement to Chapter 13, Engineering Field Handbook (EFH).

8. The Wetland Planning Checklist in EFH Chapter 13, Appendix, can serve as a guide for wetland restoration. A site visit checklist for documenting baseline wetland conditions and restoration changes is available for use.

VII. Plans and Specifications

Plans and specifications for the restoration of wetlands will be prepared for each site in accordance with the criteria for this practice.

VIII. Design Documentation

A. Design - Depending on the type of wetland restoration, the following items will be documented as applicable.

Location map, drainage area, soil boring logs, description of restoration, hydrologic and hydraulic data, typical cross section of excavations, profile along center line of embankment or ditch plug, cross section of embankment or ditch plug, profile of vegetated spillway, side slopes, elevations of inlet and outlet of pipe, length and location of subsurface drain to be removed or rendered inoperable, length and location of surface drain to be filled, inlet invert elevation of water level control structure, seeding requirements.

B. Construction (As-Built) and/or Certification Documentation Requirements - Depending on the type of wetland restoration, the following items will be documented as applicable.

Length of subsurface or surface drain removed or inoperable, cross sections of excavations (scrapes), profile along center line of embankment or ditch plug, cross section of earthfill section, elevations of pipe inlet, outlet, vegetated spillway crest, and others that were required, length of vegetated spillway control section, vegetated spillway exit slope, materials documentation, statement as to adequacy of seeding.

IX. Operation and Maintenance

An operation and maintenance plan shall be prepared for each wetland restoration site. The following examples of activities may be addressed in the plan:

1. timing and level setting of water control structures required for establishment of desired hydrologic conditions or for management of vegetation;

2. inspection schedule of embankments and structures for damage assessment;

3. depth of sediment accumulation allowed before removal is required;

4. management needed to maintain vegetation, including control of unwanted vegetation; and

5. acceptable uses and timing (e.g. grazing and haying).

X. Definitions

Structural height - Structural height is the difference in elevation (ft) between the lowest point on the embankment top and the lowest elevation of the natural channel bottom at the downstream toe of the embankment.

Class "a" - Dams located in rural or agricultural areas where failure may damage farm buildings, agricultural land, or township and country roads (NRCS TR-60).

The hydrology of the site is the rate, path, and timing of inflow and outflow; duration, frequency, and depth of flooding, ponding, or saturation.

XI. References

See listing in NRCS Engineering Field Handbook Chapter 13.

NRCS Technical Release 60, Earth Dams and Reservoirs.